Wisconsin
Department of Commerce

Evaluation # 200258-W

Safety & Buildings Division
201 West Washington Avenue
P.O. Box 2658
Madison, WI 53701-2658

# Wisconsin
# Building Products Evaluation

Material: Pre-Engineered Wood I-Joists

Manufacturers:

Pacific Woodtech Corporation
1850 Park Lane
Burlington, Washington 98233

Capital Lumber Company
2111 East Highland Avenue, Suite 155
Phoenix, Arizona 85016

Franklin Building Supply
11700 Franklin Road
Boise, Idaho 83709

Georgia-Pacific Corporation
4300 Wildwood Parkway
Atlanta, Georgia 30339

Roseburg Forest Products Company
4500 Riddle By-Pass Road
Riddle, Oregon 97469

International Paper Company/
Engineered Wood Products Division

206, 2723 – 37TH Avenue N.E.
Calgary, Alberta T1Y 5R8
Canada

## SCOPE OF EVALUATION

**GENERAL:** This report evaluates the use of Pacific Woodtech Corporation (PWC) private-labed Wood I-Joists: Franklin FBI, Georgia-Pacific Wood I-Beam®, Roseburg RFPI™, Capital CCI and Weldwood™ I-Joists, for use as

structural framing lumber engineered and the fire-resistive design requirements. **Note:** All I-Joists are identified by the designation "PWC".

This review includes the cited **Comm** code requirements below in accordance with the current **Wisconsin Uniform Dwelling Code for 1 & 2 family dwellings:**

- **Structural:** The PWC Wood I-Joists were evaluated for use in dry locations, not limited to floor and roof joists in accordance with **ss. Comm 21.02 (3)(a)** and **Comm 21.19**.

This review includes the cited **International Building Code (IBC)** requirements below in accordance with the **Wisconsin Amended IBC Code:**

- **Structural:** The PWC Wood I-Joists were evaluated for use in dry locations, not limited to floor and roof joists in accordance with **ss. IBC 2301.2**, **2301.2.1**, **2303.1**, **2303.1.2**, and **2306.1.1**.
- **Fire-Resistive Assembly:** The PWC Wood I-Joists were evaluated for use as a component of a 1-hour fire-resistive rated assembly in accordance with **ss. IBC 702.1**, **703.1**, **703.2**, **703.3**, **710.1** and **Table 719.1(3)**, **Item 21-1.1**.

## DESCRIPTION AND USE

PWC I-Joists are manufactured to meet the performance standards of PRI-400, *Performance Standard for APA EWS I-Joists,* and/or the Pacific Woodtech Corporation I-Joist Quality Control Manual. The PWC I-Joists consists of laminated veneer lumber (LVL) or machine stress rated (MSR) lumber flanges and oriented strand board (OSB) webs.

Flange stock used to fabricate the PWC I-Joists is LVL or MSR lumber of the grade required by the Pacific Woodtech Corporation Quality Control Manual.

The web sections are made up of minimum 8-foot-long (2438 mm) members that are edge-glued to form a continuous web using full thickness V-joint. The web-to-flange glued connection is made by inserting the web into a groove in the center of the flange face.

Exterior-type adhesives, complying with ASTM D2559, are used for flange-flange, flange-web and web-web joints. See **Table 1** for joist details.

**Table 1 – Joist Descriptions**

| JOIST SERIES | | JOIST DEPTHS (inches) | | FLANGE | | | WEB | |
|---|---|---|---|---|---|---|---|---|
| PRI-400[1] | PWC[2] | Minimum | Maximum | Material | Width (inches) | Depth (inches) | Material | Thickness (inch) |
| PRI-20 | PWI-20 | 9 ½ | 11 7/8 | LVL | 1 ¾ | 1 3/8 | OSB | 3/8 |
| PRI-30 | PWI-30 | 9 ½ | 11 7/8 | LVL | 1 ½ | 1 ½ | OSB | 3/8 |
| PRI-40 | PWI-40 | 9 ½ | 16 | LVL | 2 ½ | 1 3/8 | OSB | 3/8 |
| PRI-40 | PWI-40 | 9 ½ | 16 | MSR | 2 ½ | 1 ½ | OSB | 3/8 |
| PRI-40 | PWI-40 | 9 ½ | 16 | LVL | 2 5/16 | 1 3/8 | OSB | 3/8 |
| PRI-50 | PWI-50 | 9 ½ | 16 | LVL | 1 ¾ | 1 ½ | OSB | 3/8 |
| PRI-60 | PWI-60 | 9 ½ | 16 | LVL | 2 ½ | 1 3/8 | OSB | 3/8 |
| PRI-60 | PWI-60 | 9 ½ | 16 | MSR | 2 ½ | 1 ½ | OSB | 3/8 |
| PRI-60 | PWI-60 | 9 ½ | 16 | LVL | 2 5/16 | 1 3/8 | OSB | 3/8 |
| PRI-70 | PWI-70 | 11 7/8 | 16 | LVL | 2 5/16 | 1 ½ | OSB | 3/8 |
| - | PWI-93 | 11 7/8 | 16 | LVL | 3 ½ | 1 ½ | OSB | 3/8 |

**Joist Installation:** Web stiffeners are not required, with the following exceptions: (1) Web stiffeners are required at the ends of the I-Joists in joist hangers that are not deep enough to laterally support the top flange of the joist. (2) Web stiffeners are required to accommodate special hanger nailing requirements. (3) Web stiffeners are required under concentrated loads applied to the top of the I-Joist between supports, or along cantilevers beyond the support when the concentrated load exceeds 1500 pounds. (4) Web stiffeners are required at birdsmouth cuts at low-end support of sloped joists. (5) Web stiffeners are required at end reactions greater than 1500 pounds. The compression flange must be laterally supported in accordance with the applicable code, and beam-ends must be restrained to prevent rotation.

Diaphragm sheathing must be attached to the top flange and to an end wall or shear-transfer panel capable of transferring a minimum force of 50 pounds per foot (730 N/m).

**Design**: Allowable design properties are noted in **Table 2**. The tabulated moment capacity may be increased by a repetitive member factor of 1.04 for LVL flanges or 1.07 for MSR lumber flangeswhen joists or rafters are in contact or spaced not more than 24 inches on center, are not less than three in number, and are joined by floor, roof or other load distributing elements adequate to support the design load. Moment and shear capacity shall be permitted to be increased for duration of load in accordance with the applicable code.

Each PWC I-Joists shall be identified as to include the Pacific Woodtech Corporation name with a reference to the applicable research report number (**200258-W**), the listing agency certifying the product and the date of manufacture. The identification label shall be made visible for inspection.

**TESTS AND RESULTS**

**Table 2 – DESIGN PROPERTIES[1]**

| Joist Depth (inches) | Joist Series | | EI[2] ( x $10^6$ lbs-$in^2$) | M[3] (ft-lbs) | | V[4] (lbs) | IR[5] (lbs) | ER[6] (lbs) | K[7] ($10^6$ lbs) |
|---|---|---|---|---|---|---|---|---|---|
| | PRI-400[8] | PWC[9] | | LVL Flange | MSR Flange | | | | |
| 9 1/2 | PRI-20 | PWI-20 | 145 | 2180 | --- | 1,120 | 1,700 | 830 | 4.94 |
| | PRI-30 | PWI-30 | 161 | 2800 | --- | 1,120 | 1,905 | 945 | 4.94 |
| | PRI-40 | PWI-40 | 193 | 2423 | 2355 | 1,120 | 2,160 | 1,080 | 4.94 |
| | PRI-50 | PWI-50 | 186 | 3290 | --- | 1,120 | 2,040 | 1,015 | 4.94 |
| | PRI-60 | PWI-60 | 231 | 3339 | 3245 | 1,120 | 2,160 | 1,080 | 4.94 |
| 11 7/8 | PRI-20 | PWI-20 | 253 | 2910 | --- | 1,420 | 1,700 | 830 | 6.18 |
| | PRI-30 | PWI-30 | 280 | 3715 | --- | 1,420 | 1,905 | 945 | 6.18 |
| | PRI-40 | PWI-40 | 330 | 3236 | 3145 | 1,420 | 2,500 | 1,080 | 6.18 |
| | PRI-50 | PWI-50 | 322 | 4375 | --- | 1,420 | 2,040 | 1,015 | 6.18 |
| | PRI-60 | PWI-60 | 396 | 4460 | 4335 | 1,420 | 2,500 | 1,200 | 6.18 |
| | PRI-70 | PWI-70 | 420 | 5600 | --- | 1,420 | 2,335 | 1,160 | 6.18 |
| | --- | PWI-93 | 659 | 8580 | --- | 1,420 | 2,760 | 1,280 | 6.18 |
| 14 | PRI-40 | PWI-40 | 482 | 3971 | 3860 | 1,710 | 2,500 | 1,200 | 7.28 |
| | PRI-50 | PWI-50 | 480 | 5350 | --- | 1,710 | 2,040 | 1,015 | 7.28 |
| | PRI-60 | PWI-60 | 584 | 5473 | 5320 | 1,710 | 2,500 | 1,200 | 7.28 |
| | PRI-70 | PWI-70 | 613 | 7120 | --- | 1,710 | 2,335 | 1,160 | 7.28 |
| | --- | PWI-93 | 961 | 10530 | --- | 1,710 | 3,020 | 1,280 | 7.28 |
| 16 | PRI-40 | PWI-40 | 657 | 4666 | 4535 | 1,970 | 2,500 | 1,200 | 8.32 |
| | PRI-50 | PWI-50 | 663 | 6270 | --- | 1,970 | 2,040 | 1,015 | 8.32 |
| | PRI-60 | PWI-60 | 799 | 6430 | 6250 | 1,970 | 2,500 | 1,200 | 8.32 |
| | PRI-70 | PWI-70 | 841 | 8350 | --- | 1,970 | 2,335 | 1,160 | 8.32 |
| | --- | PWI-93 | 1,301 | 12360 | --- | 1,970 | 3,020 | 1,280 | 8.32 |

**NOTES:**

[1]The tabulated values are design values for normal duration of load. All values, except for EI and K, are permitted to be adjusted for other load duration as permitted by code for solid sawn lumber.

[2]Bending stiffness (EI) of the I-Joist.

[3]Moment capacity (M) of a single I-Joist. For repetitive members, the tabulated values are permitted to be increased by a repetitive member factor of 1.04 for composite lumber flanges or 1.07 for sawn lumber flanges.

[4]Shear capacity (V) of the I-Joist.

[5]Intermediate reaction (IR) of the I-Joist with a minimum bearing length of 3-1/2-inches without web stiffeners.

[6]End reaction (ER) of the I-Joist with a minimum bearing length of 1-3/4-inches without web stiffeners. Higher end reactions are permitted. For a bearing length of 4-inches (5-inch for 14-inch and 16-inch PWI-50), the end reaction may be set equal to the tabulated shear value. Interpolation of the end reaction between 1-3/4- and 4-inches (5-inch for 14-inch and 16-inch PWI-50) bearing is permitted. Web stiffeners are required when the applied stress exceeds 1550 lbs.

[7]Coefficient of shear deflection (K), shall be used to calculate uniform load and center-point load deflections of the I-Joist in a simple-span application based on Equations 1 and 2.

[8]PRI-400 Performance Standard for APA EWS I-Joists.

[9]Pacific Woodtech Corporation.

Uniform Load: $$\delta = \frac{5\omega\ell^4}{384EI} + \frac{\omega\ell^2}{K} \quad [1]$$

Center-Point Load: $$\delta = \frac{P\ell^3}{48EI} + \frac{2P\ell}{K} \quad [2]$$

where: $\delta$ = calculated deflection (in.), $\omega$ = uniform load (lbf/in.),
$P$ = concentrated load (lbf), $\ell$ = design span (in.),
$EI$ = bending stiffness of the I-Joist (lbf-in$^2$) $K$ = coefficient of shear deflection (lbf).

**One-Hour Fire-Resistive Construction for Roof-Ceiling and Floor-Ceiling Assemblies:**

**Assembly 1:** The PWC Wood I-Joists described in this evaluation, with minimum flange size of 1 ½ inches (38 mm) by 2 ½ inches (63.5 mm), can be used with the assembly described in **Figure 7** (below), of **PCF-5317**.

**Figure 7. One-Hour Fire-Resistive Floor-Ceiling Assembly (Ceiling – one layer of ½ inch or 5/8 inch gypsum wallboard, attached to furring channels spaced 24 inches on center)**

1. **Single Floor –** APA Rated Sturd-I-Floor wood structural panels (Exposure 1 or Exterior) with tongue-and-groove edges and conforming to APA Standard PRP-108, PS 1-95 or PS 2-92, with thickness, span rating and fastening in accordance with code requirements or ICBO ES or NES evaluation reports (minimum 23/32 inch nominal thickness). Installed with long dimension of panel (strength axis) or face grain of plywood perpendicular to joists with end joints staggered. The panels shall be nailed in addition to being glued to framing with construction adhesive conforming to ASTM D3498-93 (APA Specification AFG-O1). The construction adhesive shall be applied to the top flanges of I-Joists and perimeter framing using a nominal ¼ inch diameter bead of adhesive, with double beads applied where panel end joints butt. A nominal ¼ inch diameter bead of adhesive also is applied in the groove of tongue-and-groove edges of panels before joining panels together.

2. **Finish Flooring –** Approved lightweight concrete floor topping (1 ½ inch) or proprietary gypsum concrete floor topping optional over single floor, installed in accordance with an ICBO ES or NES Evaluation Report. Minimum thickness of gypsum concrete topping is ¾ inch with I-Joists spaced maximum 19.2 inches on center, or 1 inch with I-Joists spaced 24 inches on center.

3. **Wood Structural Members –** Minimum 9 ½ inch deep wood I-Joists spaced maximum of 24 inches on center, installed in accordance with requirements of this evaluation. Top and bottom flanges, minimum size 1 ½-inch x 2 ½-inch LVL (C Series), or 1 ½-inch x 2 ½-inch lumber (S Series); minimum web thickness, 3/8-inch. Minimum 2 inches bearing on supports. Holes may be cut in web of I-Joist as permitted by this evaluation and the manufacturer's installation instructions.

4. **Insulation –** 1-inch thick unfaced mineral wool batt insulation (minimum 6 pounds per cubic foot density) shall be placed under the bottom flange of I-Joists and supported on furring channels. Edges of the insulation batts shall be tightly butted against the furring channel support clips and adjoining insulation batts, and ends shall be located over furring channels.

5. **Furring Channels –** Inverted hat-type channels, 7/8-inch deep x 2 5/8 inches wide, formed of minimum 0.021-inch thick (25 gage) galvanized steel. Channels shall be installed perpendicular to I-Joists in continuous rows spaced 24

inches on center. Channels shall be attached to the bottom flange of each I-Joist with one support clip (Simpson Strong-Tie Co. Type CSC) at each crossing. Support clips shall be nailed to I-Joist flange with one 11 gage (0.1205-inch diameter) x 1 ½-inch nail. At locations of end joints of gypsum wallboard, install double row of channels, centered 1 ½-inches from panel ends. Ends of channel shall extend a minimum of 6 inches beyond the edge joint of adjoining panels. Channels splices shall be centered under the I-Joists and overlapped a minimum of 6 inches, and tied together with double strand of No. 18 SWG galvanized steel wire near each end of overlap.

6. **Wallboard,** Gypsum –Approved ½-inch or 5/8-inch proprietary Type X gypsum wallboard, 48 inches wide, installed perpendicular to furring channels (parallel to I-Joists) with end joints continuous or staggered. Fasten to furring channels with 1-inch or 1 1/8-inch Type S drywall screws spaced 12 inches on center. Drywall screws shall be driven so that they are flush with the face and do not damage the core of the wallboard, and shall be located 1 ½ inches from panel ands and a maximum of 6 inches from panel edges. The wallboard shall be:

- National Gypsum Fire-Shield G gypsum wallboard.
- U.S. Gypsum Firecode C gypsum wallboard, or approved equal.

7. **Finishing System** (not shown) – Exposed face layer joints shall be covered with tape and joint compound, screw heads shall be covered with joint compound.

**Assembly 2:** I-Joists can be used in the construction of the assembly described in **IBC Table 719.1(3)**, **Item 21-1.1**. Minimum 9 ½ inch-deep (241 mm) wood I-Joists are spaced a maximum of 24 inches (610 mm) on center. Minimum flange size is 1 5/16 inches thick by 1 ½ inches wide (33 mm by 38 mm). Minimum web thickness is 3/8-inch (9.5 mm).

**Assembly 3:** The I-Joists described in this evaluation can be used with the assembly details described in Section 2.3.3 of ICBO ES report PFC-5317.

**Assembly 4:** The assembly consists of the following: Finish flooring (option) – Hardwood or softwood flooring on building paper; or resilient flooring, parquet floor, felt-synthetic-fiber floor coverings, carpeting, or ceramic tile on 3/8-inch-thick (9.5 mm) panel-type underlay; or ceramic tile on 1 ¼-inch (32 mm) mortar bed.

**Subfloor –** Wood structural panel sheathing in compliance with the provisions of PS1 or PS2 and the code.

**Wood structural members –** Minimum 9 ½ inch-deep (241 mm) wood I-Joists spaced a maximum of 24 inches (610 mm) on center. Minimum flange size is 1 ½ inches thick by 1 ½ inches wide (38 mm by 38 mm). Minimum web thickness is 3/8-inch (9.5 mm).

**Insulation** (optional) – 3 ½ inch (89 mm) glass fiber batts. Three-and one-half-inch-thick (89 mm) mineral wool batts.

**Resilient channels –** Minimum 0.018 inch thick (0.46 mm). The resilient channels must be installed in continuous rows perpendicular to the joists at a maximum of 24 inches (610 mm) on center. The channels are attached to the bottom of each joist with a 1 ¼-inch (32 mm) screw. Additional channels may be installed between continuous rows at the locations of end joints in the first layer of ceiling. The additional channels are extended a minimum of 2 inches (51 mm) beyond the joists adjacent to each side of the gypsum board panels in the first layer of ceiling.

**Ceiling –** The ceiling membrane consists of two layers of ½-inch-thick (12.7 mm) Type X gypsum board in compliance with ASTM C36. The gypsum is installed with the long edge of both layers perpendicular to the channels (parallel to the joists). End and side joints are staggered at least 16 inches (406 mm) from layer to layer. The first layer is attached with 1 ¼-inch (32 mm) Type S screws at 12 inches (305 mm) on center. Minimum distance of screws from end and side joints of the gypsum board is 3/8-inch (9.5 mm) and 1 ½ inches, respectively. The second layer is attached to the resilient channels with 1 5/8-inch (41 mm) Type S screws at 12 inches on center. Minimum distance of screws from end and side joints is ½-inch (12.7 mm). One-and-one-half-inch Type G screws may be substituted at end joints in the second layer when end joints fall between channels.

Testing in accordance with the Standard, Fire Tests of Building Construction and Materials, ANSI/UL 263 (ASTM E119 , NFPA No. 251) was performed on non-veneer oriented strand board (OSB) sub-flooring and finish flooring panels.

**Results**: Fire-Resistance Properties: It is judged that floor-ceiling assemblies constructed of the materials and in the manner herein described, will afford a 1-hour protection against passage of flame and dangerous heat transmission. Fire testing in accordance with standard, Fire Tests of Building Construction and Materials (ANSI/UL 236, ASTM E119, NFPA No. 251) was performed on floor-ceiling assemblies using wood I-joists and plywood or non-veneer (oriented strand board, OSB) subflooring and finish materials. The assemblies carried the rated live and dead load imposed upon it during the fire endurance test. APA EWS performance-rated I-

joists may be used as a component of one-hour fire-resistance rated floor-ceiling assemblies. See TEST AND RESULTS section of this evaluation.

## LIMITATIONS OF APPROVAL

**Table 2** may be used without the submittal of calculations. Provide the following information on plans submitted for each project: material approval number, series number identification, spans, spacing, load conditions, bearing details and other information required by **s. Comm 20.18** or **s. Comm 61.60** of the current Uniform Dwelling Code and Wisconsin Commercial Building Code, respectively.

Increases for duration of load provided for wood members and their connections may be used in accordance with the "National Design Specification for Wood Construction" (2.3.2) and its supplement.

The PWC Wood I-Joists are approved for the moment and shear values shown in **Table 2**.

This approval is based on simple span uniformly distributed load conditions and multiple span conditions for floors (see span tables in manufacturer's product literature). Any variation will require submittal of calculations for the project.

The design properties are for dry-use conditions and under no circumstances shall the joists be permanently exposed to the weather.

Installation of PWC Wood I-Joists shall be in accordance with the manufacturer's published installation instructions and this approval. If a conflict between the manufacturer's instructions and this approval occur, the conditions set forth in this approval shall govern.

The PWC Wood I-Joists are approved for use where hourly rated construction is required by Wisconsin Commercial Code, when they are part of a listed assembly.

This approval will be valid through December 31, 2007, unless manufacturing modifications are made to the product or a re-examination is deemed necessary by the department. The Wisconsin Building Product Evaluation number must be provided when plans that include this product are submitted for review.

## DISCLAIMER

The department is in no way endorsing or advertising this product. This approval addresses only the specified applications for the product and does not waive any code requirement not specified in this document.

Revision Date:
Approval Date: February 10, 2003 By: _____

Lee E. Finley, Jr.
Product & Material Review
Integrated Services Bureau

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